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REVIEW

D. H. MELLOR

The Matter of Chance

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Luke Glynn

lglynn@caltech.edu

Though almost forty years have elapsed since its first publication, it is a testament to the philosophical acumen of its author that *The Matter of Chance* contains much that is of continued interest to the philosopher of science. Mellor advances a sophisticated propensity theory of chance, arguing that this theory makes better sense than its rivals (in particular subjectivist, frequentist, logical and classical theories) of 'what professional usage shows to be thought true of chance' (p. xi)–in particular 'that chance is objective, empirical and not relational, and that it applies to the single case' (ibid.).

The book is short and dense, with the serious philosophical content delivered thick and fast. There is little by way of road-mapping or summarising to assist the reader: the introduction is hardly expansive and the concluding paragraph positively perfunctory. The

result is that the book is often difficult going, and the reader is made to work hard to ensure correct understanding of the views expressed. On the other hand, the author's avoidance of unnecessary use of formalism and jargon ensures that the book is still reasonably accessible.

In the following, I shall first summarise the key features of Mellor's propensity theory, and then offer a few critical remarks.

I

Propensities, according to Mellor (p. 63), are dispositional properties of persisting entities (which include the 'common physical things with which science begins its enquiries'–ibid.). The attribution of a dispositional property *F* (whether a propensity or otherwise) to an entity *a* at time *t* entails the truth of a subjunctive (or counterfactual) conditional of the form 'if *a* were involved in a situation of kind *K* at time *t*, the situation would have the characteristic property *P*' (p. 64). In Mellor's terminology, the property *P* is the *display* of the disposition, whilst the situation that bears *P* is a *trial* (p. 68). Illustration: *fragility* is a dispositional property that one might ascribe to a *glass* at *1pm*. Such an ascription entails the truth of the subjunctive 'if the glass were dropped on a hard floor at 1pm, then it would break'. The display of the glass's fragility, namely its *breaking*, is elicited by a trial of the kind *dropping of the glass on a hard floor*.

Propensities differ from other dispositions in one crucial respect: they have as their displays, not *events* (such as breakings), but rather *chance distributions* over sets of possible events (pp. 66-7). Thus *bias* is a propensity that might be ascribed to coin *a* (which being the bearer of a propensity is called a *chance set-up*–p. 67). The display of the coin's bias is a certain chance distribution P_a over the set of possible events {*Heads*, *Tails*, *Edge*}. This display would be elicited by a chance trial of the kind *flipping with a standard flipping device*.

An obvious question arises as to why we should regard some dispositional properties to be displayed in *events*, whilst others (propensities) are displayed in *chance distributions over events*. Mellor's response: '[p]hysical dispositions of objects […] are invariable in their display' (p. 65). By this he means that any object failing to display a disposition in a situation or trial of the appropriate kind is thereby shown not to have the disposition at that time (pp. 64-5). Thus: '[a] glass that does not break when [suitably] dropped is at that time not fragile' (p. 68). But, by the very nature of chance set-ups, trials upon them have variable results (ibid.). Dispositional properties of chance set-ups cannot therefore be displayed in these results, but must instead be displayed in the chance distributions over the various possible results, which *are* invariable (given an appropriate kind of trial).

Dispositional property ascriptions (including propensity ascriptions) can be genuinely explanatory provided that they can be made on grounds other than the display that they are intended to explain (the 'dormative virtue' explanation of a drug's soporific effect is problematic to the extent that we are ignorant of such alternative grounds–p. 65). Thus the scientifically respectable, explanatory, dispositions are those that can be ascribed on the basis of their nomic connections with other scientifically respectable properties of an object (pp. 65-6, 104-5). For example, a glass's shattering can be explained in terms of its fragility because the latter is lawfully connected to such further properties as molecular structure.

That scientifically respectable dispositions are ascribable on grounds other than their displays is a corollary of a principle that Mellor calls 'connectivity', which he claims (plausibly enough) to govern the scientific characterisation of physical systems. According to this principle, two physical systems cannot differ in a single property only (p. 115). The principle is *regulative* rather than *empirical* (pp. 118-9, 174): a scientific characterisation that was incompatible with it would simply be rejected as inadequate. Connectivity thus implies that any scientifically respectable property of a physical system supervenes upon its other such properties.

Since Mellor claims that propensities are respectable scientific properties, he holds them to be subject to connectivity (pp. 120-1). He shows how this allows us to pin down certain chance distributions that display them. As an example, he considers the bias of a coin (pp. 122-7). *Bias*, being a respectable propensity, is nomically connected to other properties of a coin, such as its centre of gravity, and its magnetisation. Thus suppose we have a physical system, coin *a*, to be flipped by a standard flipping device. For simplicity suppose that *Heads* and *Tails* are the only possible results of this trial (there is no chance of *Edge*). The bias of the coin is thus displayed in the chance distribution $P_a = \langle p_a(Heads), p_a(Tails)\rangle$. Now suppose that I write 'T' in chalk on the heads side and 'H' on the tails side of the coin. And let us suppose that such superficial markings are not connected to bias. Call the resulting physical system '*b*' (obviously *a* and *b* are not *distinct*–but this does not prevent the application of connectivity). Let *H* be the proposition that *b* lands H side up, and let the bias of *b* be displayed in the chance distribution $P_b = \langle p_b(H), p_b(T)\rangle$ to which a standard flip gives rise. Finally, suppose that every true proposition ascribing a property connected to bias to the heads side of *a* is true also of the H side of *b* (and there are no more true propositions ascribing properties connected to bias to the H side of *b*). Likewise for the tails side of *a* and the T side of *b*. Then connectivity implies that $p_a(Heads) = p_b(H)$ (and $p_a(Tails) = p_b(T)$). But note that the H side of *b just is* the tails side of *a*. Consequently, we get the result that $p_a(Heads) = p_a(Tails) = ½$. Connectivity thus implies that a symmetric bias (as measured by the chance distribution to which it gives rise) follows from symmetry in all respects connected to bias.

Having shown how connectivity acts as a substantive constraint upon propensities, Mellor turns to his final two tasks which are, first, to argue that propensities may be displayed even in worlds with deterministic microdynamics (pp. 151-7) and, second, to show that his propensity view is compatible with Humeanism (pp. 157-74). I shall discuss the second of these arguments in greater detail below.

II

Some critical remarks. The first concerns Mellor's claim that dispositions are invariable in their display. It is not clear what justifies this claim. Certainly Mellor does not marshal linguistic evidence concerning everyday ascriptions of dispositional properties in support of it. Indeed, at one point (p. 65) he seems to suggest that it is merely to be taken stipulatively. But to take it as such is problematic because invariability is Mellor's only reason for distinguishing propensities from deterministic dispositions. This distinction is critical to Mellor's account, for his central idea is that propensities explain the chance distributions that are their displays in a manner exactly analogous to that in which deterministic dispositions explain the events (e.g. the breakings, dissolvings, and fallings-asleep) that are *their* displays. Just as the glass's fragility explains its breaking when dropped, so the coin's bias explains its chance ½ of landing heads when flipped.

But if there is no good reason for supposing invariability, then we can't be sure that this is the correct analogy. Indeed, I would say that it is fairly clearly *incorrect*. For note that *all* dispositions, whether deterministic or not, give rise to (possibly trivial) chance distributions over the possible results of the trials that elicit their displays. It seems to me, therefore, that the explanatory relationship between the fragility of the glass and the *trivial* chance distribution to which (we might suppose) a dropping of the bottle would give rise is the proper model for that between the bias of a coin and the *non-trivial* chance distribution that a flipping of it would yield.

If this is correct, then the substantial effort that Mellor invests throughout the book to make compelling the thesis that deterministic dispositions can be genuinely explanatory of their results is of little help in demonstrating that propensities are explanatory of chance distributions. Nor is it at all obvious how such a demonstration would go.

A second critical observation is that, insofar as Mellor's appeal to dispositions really provides us with a deep metaphysical account of chance, that account just seems to be false. It has been seen that Mellor sketches a (somewhat misleading) picture of the relationship of chance distributions to dispositional properties called *propensities*. But one might wonder whether he has thereby provided an account of what a chance distribution *is*. Certainly he does not intend to *reduce* chances to dispositions. He is quite clear that the two are distinct (p. 71)–the propensity is the disposition, the chance distribution its display. In general the things that display dispositions cannot plausibly be reductively analysed in terms of the dispositions themselves–the notion of an *event* is not plausibly analysed in terms of deterministic dispositional properties of objects. And, although an analysis of dispositions in terms of their displays may well be plausible, it is not available to someone who like Mellor aims to give an illuminating account of chance as the display of a dispositional property.

So Mellor hasn't given a reductive analysis of chance. Nor, it appears, has he sketched a theoretical *constraint* upon chance in terms of disposition. It seems that Mellor (anticipating Lewis [1980]), takes a fully adequate implicit definition of chance to be that in terms of its role in guiding reasonable partial belief (e.g. pp. 2-3, 52). The further claim that '[k]nowledge of [...] propensity on the present theory is what in suitable circumstances makes reasonable the having of some particular partial belief' (p. 2; see also p. xii) seems, if anything, to have the status of an *a posteriori* identification of propensity as that which plays the chance-role.

On the face of it, this in itself seems puzzling. For, on the one hand, Mellor distinguishes chance from propensity but, on the other, propensity is taken to be the player of the chance-role in guiding reasonable credence. So perhaps we have here at last a substantive metaphysical thesis–Mellor proposes neither a *reduction* of chance nor sketches a *constraint* upon it, but rather recommends a metaphysical *elimination*. Thus: '[t]he bias of the coin replaces the chance distribution as the feature of the world which warrants some partial beliefs rather than others in events that are outcomes of the toss' (p. 70). Mellor later says of

the distinction between chance and propensity that it 'must be drawn if only to propose a change of usage that might make it redundant' (pp. 81-2), and has earlier said that propensity 'may in due course displace chance distribution as the primitive objective concept' (p. 62). The chance distribution, which is taken to be the display of the propensity, is merely 'the measure of [...] reasonable partial belief' (p. 2), and Mellor speaks of his intention as having been to 'identify chance with warranted partial belief' (p. 72).

If this interpretation is correct, then Mellor does after all furnish a deep metaphysical account of chance–or rather he makes a deep metaphysical claim about it (namely that it drops out of the ontology altogether, replaced by propensity which is a rather different sort of thing). The trouble is that, if this is the metaphysical thesis he indeed intends, then I think it is an incorrect thesis. If we must take only one of propensity and chance as the primitive objective concept, there are much better reasons to choose the latter.

This is not the place to attempt a full defence of that claim. I wish merely to point out that, concerning Mellor's 'demonstrations' of the two principal virtues he claims for his propensity theory–first, that it allows the derivation of classical probabilities (such as the chance ½ of a symmetric coin landing heads when tossed) without appeal to ignorance or insufficient reason and, second, that it explains how objective features of the world can constrain reasonable partial belief–neither makes essential appeal to *propensities* and, moreover, his demonstration of the second *does* make essential reference to *frequencies*. Far from showing that chance is eliminable in favour of propensity, Mellor's arguments only serves to lend plausibility to a (sophisticated) frequentist analysis of the former.

With regard to Mellor's derivation of classical chance distributions, nothing in it really turns upon such distributions being displays of respectable dispositional properties. Of course his claim that they are allows him to bring to bear the plausible principle of connectivity to constrain these distributions by constraining the corresponding propensities. But someone rejecting this claim can ensure that the chance distributions are similarly constrained just so

long as she subscribes to the supervenience of the chance on the non-chance properties of a physical system. And, irrespective of whether chances are grounded in propensities, such supervenience is highly plausible and indeed will be entailed by, for example, a sophisticated frequentism (such as Lewis's ([1994]) Best System Analysis). The appeal to propensities is quite superfluous.

Now consider Mellor's claim that his theory accounts for the constraint of reasonable partial belief by objective features of the world. According to Mellor, it is in virtue of the truth of a probabilistic law that it is uniquely reasonable to have degree of belief *p* in an appropriate trial on a chance set-up of kind *A* resulting in an outcome of kind *B* (p. 164). His argument that this is so appeals to the fact that a gambler who is constrained to aim at avoiding a loss rather than making a profit and who repeatedly bets on *A*s being accompanied by *B*s (on appropriate trials) will, with arbitrarily high chance, be arbitrarily close to breaking even after a sufficient number of bets, provided that she chooses a coherent betting quotient equal to the probability *p* (pp. 160-5). Now there are several worries about Mellor's argument, not least concerning the reference to the 'arbitrarily high chance' of breaking even. But the important point to press is that it is *entirely* unclear that the gambler can expect to break even by adopting such a strategy unless the probabilistic law in question is made true by facts about the frequency with which *B*s accompany *A*s (or perhaps by some sort of non-Humean 'partial compulsion', resort to which Mellor is keen to avoid, pp. 157-8).

Indeed, a frequentist conception of probabilistic law seems to be the one that Mellor is relying upon. For, although he insists that probabilistic laws are not *merely* assertions of frequent conjunctions (p. 160), his point seems only to be that an adequate Humean-frequentist account of laws must discriminate genuine probabilistic laws (which support subjunctive conditionals) from *mere* frequencies that are not genuine laws (and do not support subjunctives) (pp. 164, 171-2). Such a Humean-frequentist view would accommodate Mellor's discrimination between those (connected) properties of a chance set-up that are

relevant to determining the chance distribution resulting from a trial upon it from those properties that are not. This may be behind Mellor's admission that his account can be reconciled with a sophisticated frequentism (p. 2).

I have suggested that it is only by virtue of a probabilistic law's being made true by frequency facts that a probability distribution it entails can constrain reasonable partial belief (see Lewis [1994]). I have also said that Mellor does indeed appear to rely upon a frequentist conception of probabilistic law. Indeed, the sort of probabilistic law that Mellor seems to have in mind is one that gives, as a function of the connected properties of a chance set-up, the chance distribution that displays its propensity (pp. 172-3). For example, Mellor supposes we might know (within limits of imprecision and holding other connected properties fixed) that there is a certain quantitative relationship between the centre of gravity of a coin and its chance of heads on a standard flip (p. 126). But, on this conception, the probabilistic laws relate the connected properties to the chance distributions directly, making redundant an appeal to propensity as a 'primitive objective concept'.

So it seems to be facts about frequencies rather than propensities that do the real work in making probabilistic laws true and constraining reasonable partial belief, the latter of which roles Mellor himself takes to be definitive of chance. It therefore seems misguided of him to seek an account of chance in terms of propensity, let alone an elimination of the former in favour of the latter.

Although I have raised objections to Mellor's use of the notion of propensity to explicate that of chance, the book still contains much of interest. In particular, Mellor provides as compelling a case as any that has been advanced for the scientific respectability of dispositional properties, and in particular for their ability to figure in genuinely illuminating explanations (of the events which are their results even if not of the chance distributions to which they give rise). And, although I have been unable to discuss them here, Mellor's discussions of the nature of partial belief (Chapters 1-2), of imprecision and inexactness

(Chapter 6), and of the relationship between determinism and chance (Chapter 8) are all highly illuminating.[1]

References

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